BITX20A

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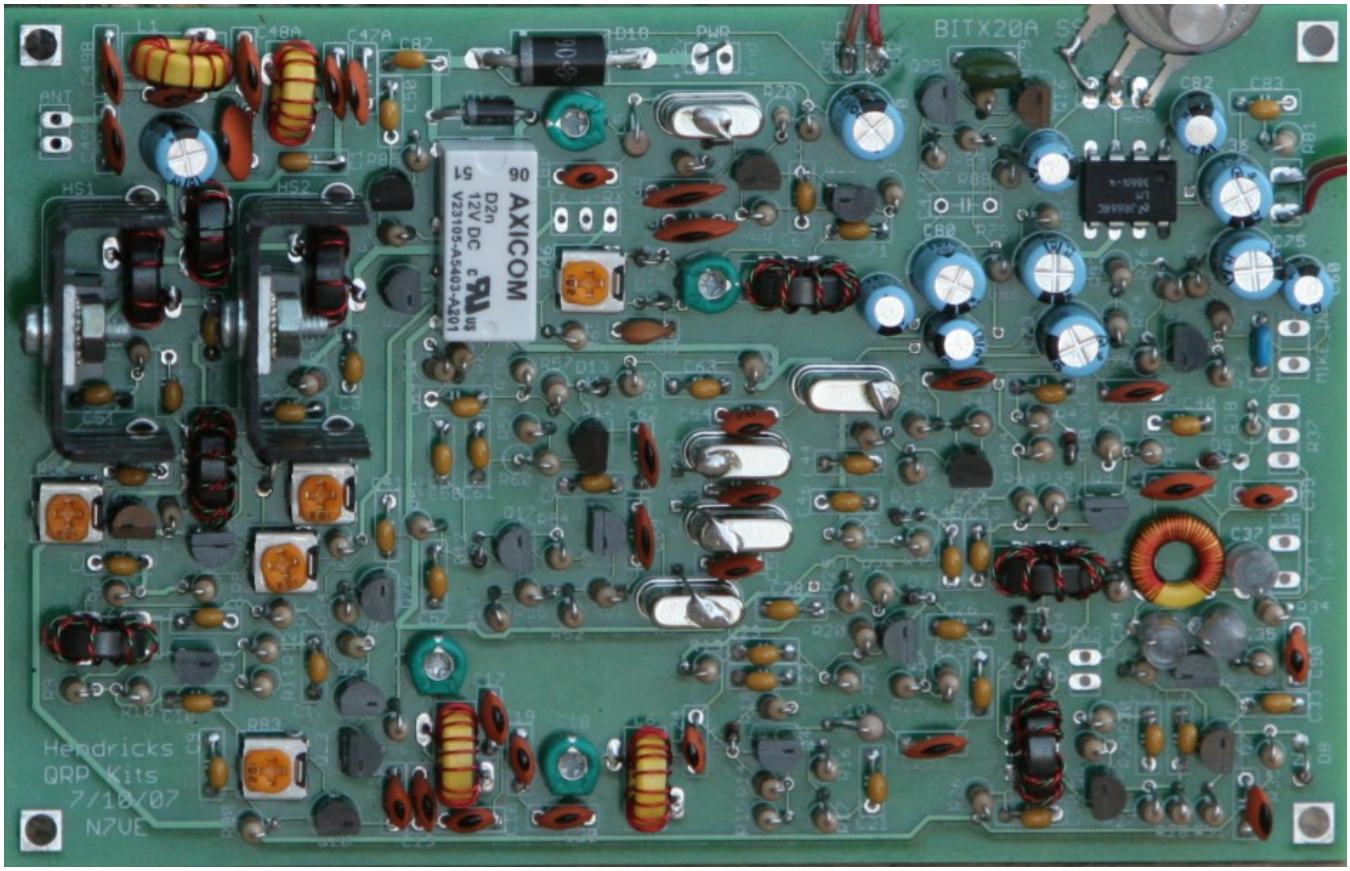

10w SSB Transceiver for 20m

Complete Enhanced Build Notes

by Dan Tayloe, N7VE

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Parts List Summary

This is an inventory of the parts that should be included in this kit:

Quantity	Value	Device
1	160 pf	External tuning cap
5	10 uf	POLARIZED CAP
7	100 uf	POLARIZED CAP
1	220 pf	POLYSTYRENE
2	470 pf	POLYSTYRENE
4	30 pf	Trimm capacitor
1	0.01 uf	
40	0.1 uf	
3	10 pf	
10	100 pf	
1	15 pf	
3	180 pf	
2	220 pf	
3	33 pf	
1	0.022 uf	
2	56 pf	
1	8.2 pf	
4	82 pf	

Quantity	Value	Device
16	2N3904	
1	2N5486	
4	2N7000	
2	BS170	
1	FQN1N50C	
2	IRF510	
2	200	3318_TRIMMER
3	10K	3318_TRIMMER
1	10k	Fine tune external pot
1	10k	Volume control external pot
1	2.2	Resistors
1	4.7	

Quantity	Value	Device
9	10	Resistors
2	22	
13	100	
14	220	
2	470	
3	10K	
2	150 K	
15	1K	
11	2.2K	
1	2.7K	
1	22K	
1	3.3K	
11	4.7K	
5	11 MHz	XTAL/S

Quantity	Value	Device
1	33v	ZENER_DO35_V
1	5.6v	ZENER_DO35_V
1	9.1v	ZENER_DO35_V
1	1N4004	
12	1N4148	
1	SB320	
2	HEATSINK	
1	LM386-4	
1	RELAY	
1	1.2 uH	molded choke
1	8.2 uH	molded choke
8	FT37-43	
5	T37-6	

Bare PC Board

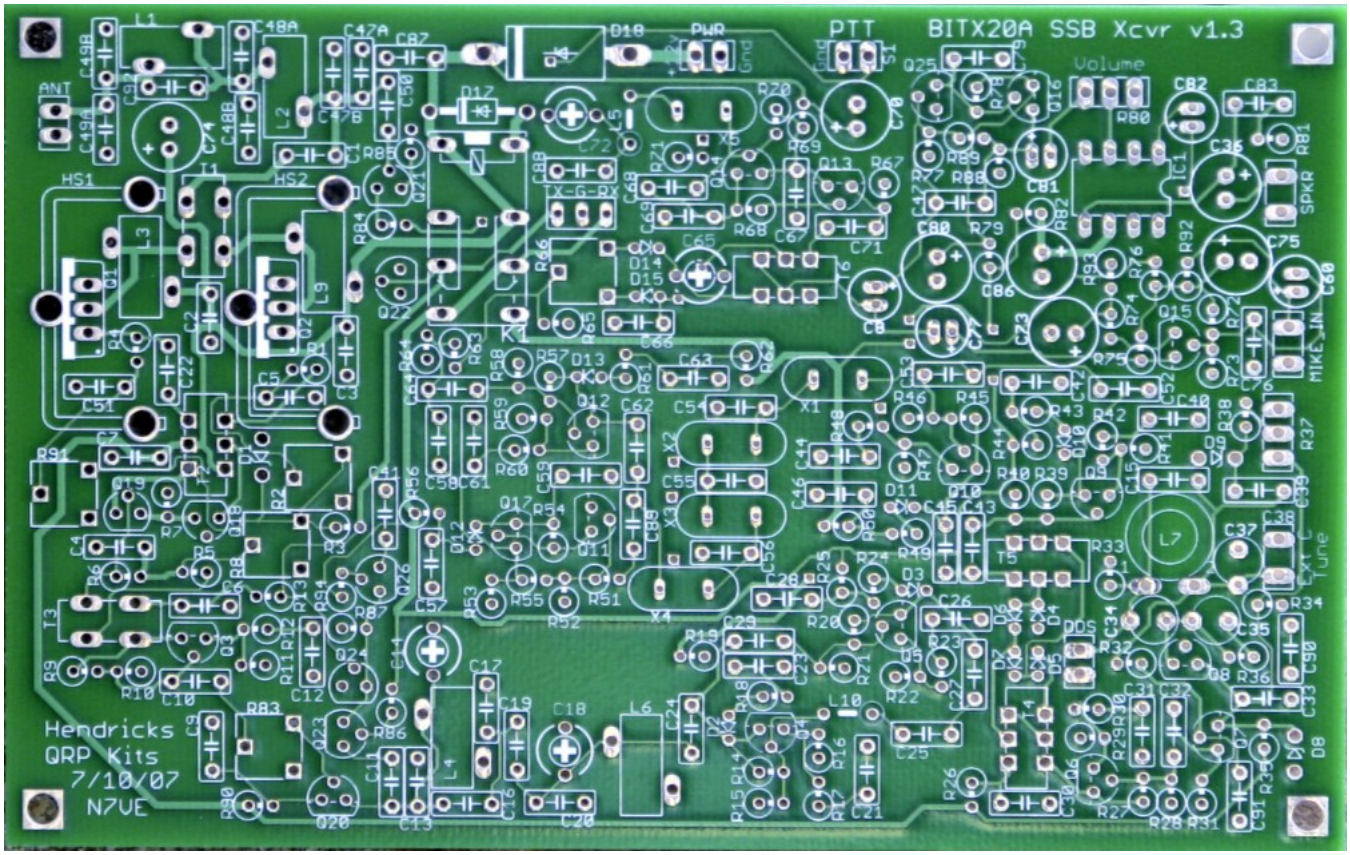

Figure 1. Top side view of the BITX20A v1.3

First section – Misc Parts installation

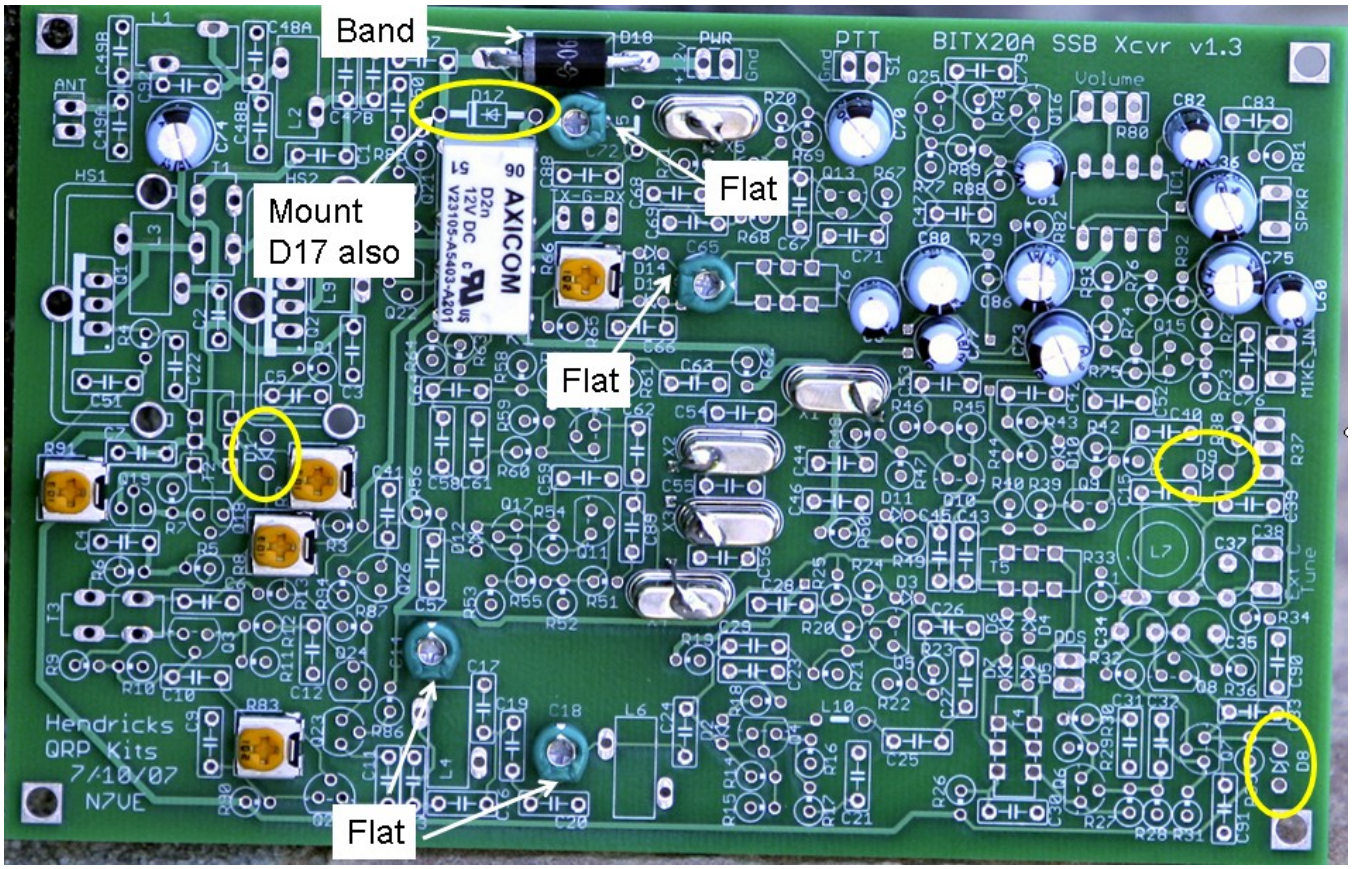

Figure 2. Picture of the Misc Section with Parts Mounted

There are a bunch of parts in this section that will we pre-mount just to get them out of the way.

Install ☐ K1 White relay.

Install 0.1 uf caps (marked "104"). ☐ C87 Located next to D10.

Install 10K trimmer resistors (marked 103). ☐ R2, ☐ R8, ☐ R91

Install 200 ohm trimmer resistors (marked 201). ☐ R66, ☐ R83

Install all trimmer caps ☐ C14, ☐ C18, ☐ C65, ☐ C72. **Note:** The trimmer caps have a flat side and a rounded side. **Double check the flat side of the trimmer cap against the orientations shown above.** We want to mount the trimmer caps so that the adjustment slot is grounded. This makes adjustments easier. The above orientation does that.

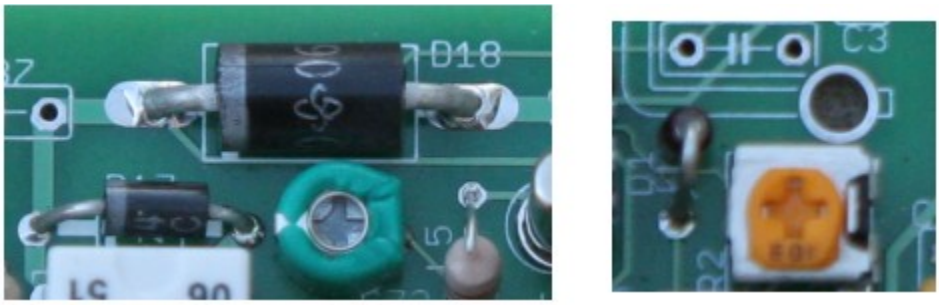

Figure 3. D17 & D18 mounted Horizontal, D1 mounted on end, band point up

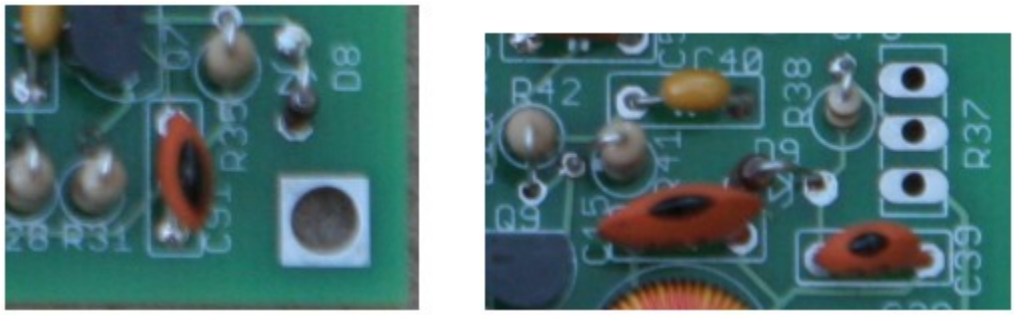

Figure 4. D8 and D9 mounted vertically, band end up

Install ☐ D17 1N4004, ☐ D18 SB320, ☐ D8 1N5239A, ☐ D9 1N4752A/1N5257B, ☐ D1 1N4734A, **Double check the polarity against the above pictures! Check the diode band polarity against the diode band outline on the board.**

Install all 100uF polarized capacitors. ☐ C36, ☐ C70, ☐ C73, ☐ C74, ☐ C75, ☐ C80, ☐ C86. These are polarized capacitors, ***so make sure they are installed with the correct polarization***. The black stripe on the top of the cap is the negative side of the capacitor. The non-striped side matches with the "+" symbol marked on the board. **Double check against the orientation on the board shown above.**

Install all 10uF polarized capacitors. ☐ C8, ☐ C60, ☐ C77, ☐ C81, ☐ C82. These are polarized capacitors, ***so make sure they are installed with the correct polarization***. The black stripe on the top of the cap is the negative side of the capacitor. The non-striped side matches with the "+" symbol marked on the board. **Double check against the orientation on the board shown above.**

Install all 11 MHz crystals. ☐ X1, ☐ X2, ☐ X3, ☐ X4, ☐ X5. ***Each crystal should have a wire attached to connect the case to ground as shown in the figure above.*** A small square hole has been provided next to each crystal for these ground wires to be attached to. Scrap leads from the parts above can be used for these ground wires.

Also recommended for testing is to temporarily attach a switch across the PTT pads along the top edge. This allows an easy check for the receive tests (switch open) and transmit tests (switch closed).

Misc Section Tests

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 0 ma, since there is nothing at this point that draws current.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 33 ma using a 12v supply. At this point, the only part that is drawing current is the 12v relay.

At this time, remove the 12v power connection.

Audio Power Amplifier

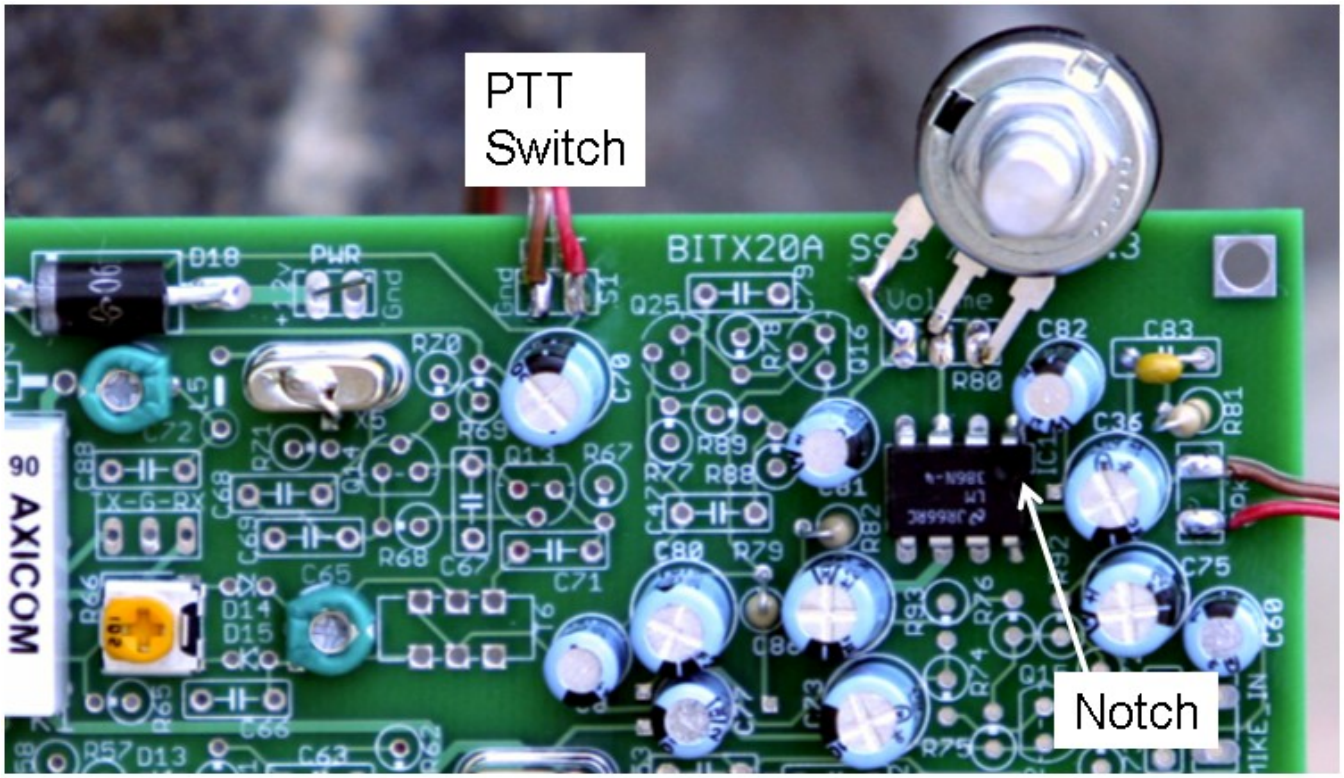

Figure 5. Receiver LM386 Audio Amplifier Section

Install ☐ IC1 (LM386). **Make sure the notch of IC1 matches up with the notch on the board!**

Install 0.1 uf caps (marked "104"). ☐ C83

Install 10 ohm resistors (Brown/Black/Black/Gold). ☐ R81, ☐ R82

Install 220 ohm resistors (Red/Red/Brown/Gold). ☐ R79

Temporarily install ☐ R80 (volume control pot). I just tacked two of the three resistor leads right to the pads, and then used a lead scrap for connecting to the third lead. You could just use wires instead.

Temporarily install an external speaker jack so that we can listen to the audio output (across the pads marked "SPKR").

Audio Power Amplifier Tests

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 6 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 33 ma using a 12v supply. At this point, the only part that is drawing current is the 12v relay.

☐ Listening test: Touch the C81 end of R80 with your finger. With the R80 volume control turned all the way up, a loud hum ought to be heard from the speaker.

At this time, remove the 12v power connection.

Receiver Audio Preamplifier

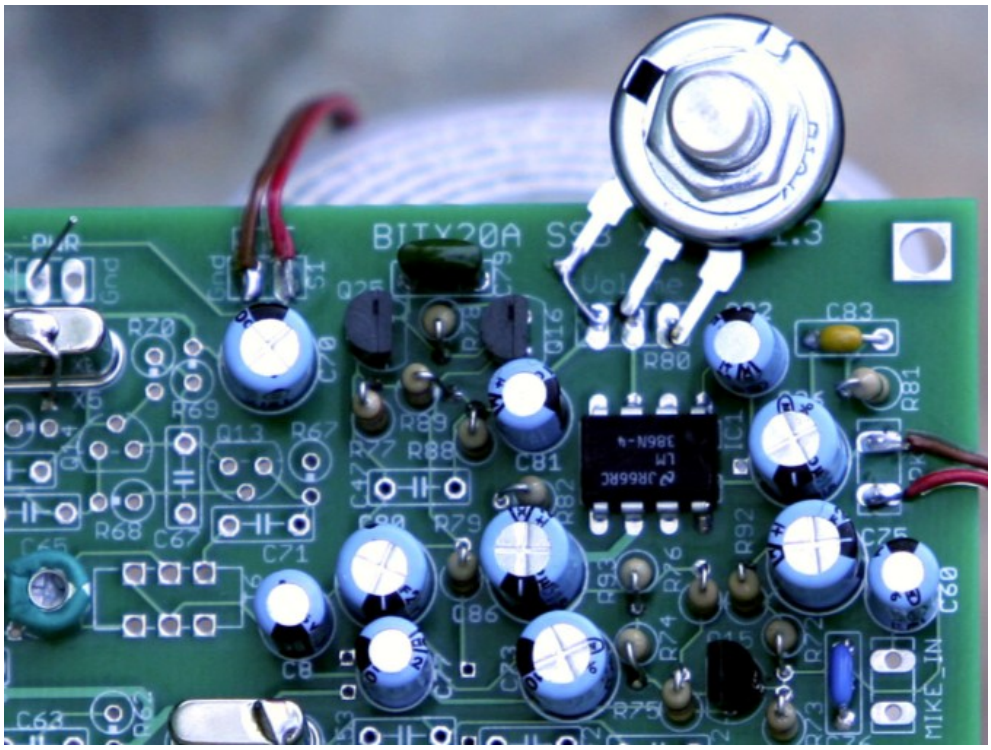

Figure 6. Two Transistor Receiver Audio Preamplifier

Install 2N3904 transistors ☐ Q16, ☐ Q25. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.022 uf caps (marked "223") ☐ C79. This is the only large green cap.

Install 4.7K ohm resistors (Yellow/Violet/Red/Gold). ☐ R78, ☐ R88

Install 3.3K ohm resistor (Orange/Orange/Red/Gold). ☐ R77

Install 22K ohm resistor (Red/Red/Orange/Gold). ☐ R89

Audio Pre-amplifier Tests

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 8 ma.

☐ Measure the voltage across R88 with the PTT switch open (receive). With R88 mounted on end as shown, measure from the resistor top lead to ground. ~5v should be seen.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 33 ma using a 12v supply. At this point, the only part that is drawing current is the 12v relay.

☐ Listening test: When in the receive mode (PTT switch open), touch the left most unused pad of C47 with a spare wire scrap. With the R80 volume control turned all the way up, a very loud noise ought to be heard from the speaker.

At this time, remove the 12v power connection.

Transmit Microphone Preamplifier

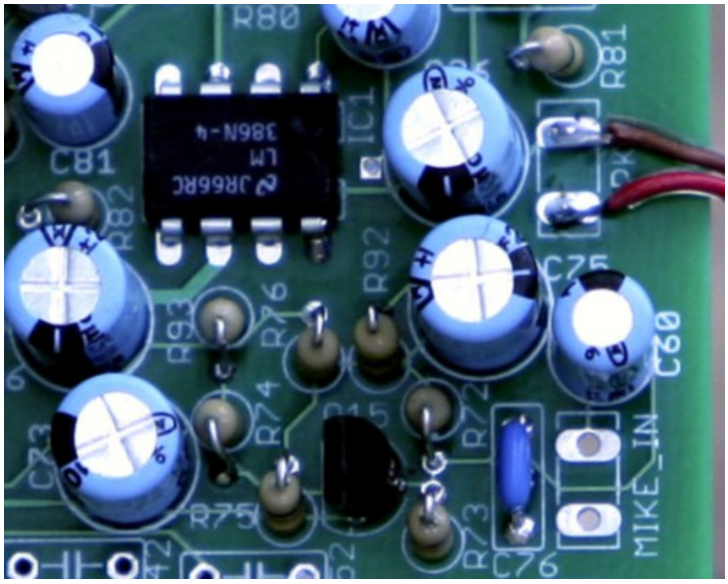

Figure 7. Transmit Microphone Preamplifier

Install 2N3904 transistors: ☐ Q15 **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.01 uf (marked "103") capacitor: ☐ C76

Install 10 (marked brown-black-black-gold) resistor: ☐ R76

Install 100 (marked brown-black-brown-gold) resistor: ☐ R74

Install 220 (marked red-red-brown-gold) resistor: ☐ R93

Install 1K (marked brown-black-red-gold) resistors: ☐ R75

Install 2.7K (marked red-violet-red-gold) resistors: ☐ R73

Install 4.7K (marked yellow-violet-red-gold) resistors: ☐ R92

Install 10K (marked brown-black-orange-gold) resistors: ☐ R72

Transmit Microphone Preamplifier Tests

☐ Connect 12v to the “PWR” pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 8 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 39 ma using a 12v supply.

☐ Now close the PTT switch (transmit) and measure the voltage from the top of R74 to ground. This should be is 1.7v

At this time, remove the 12v power connection.

Second mixer stage

The first thing here is to pre-wind the wire that will be used for the three winding transformers (“tri-filar”) and the two winding (“bifilar”) transformers.

There are two different sets of red wire. Measure 3 feet of the larger red wire. Also measure 3 feet of green and three feet of brown wire. Place a bent nail in a drill chuck and twist on end of the three wires around the bent wire. Take the other end of the three wire set and twist it around something stationary.

Below are pictures showing the drill side of this twisting process.

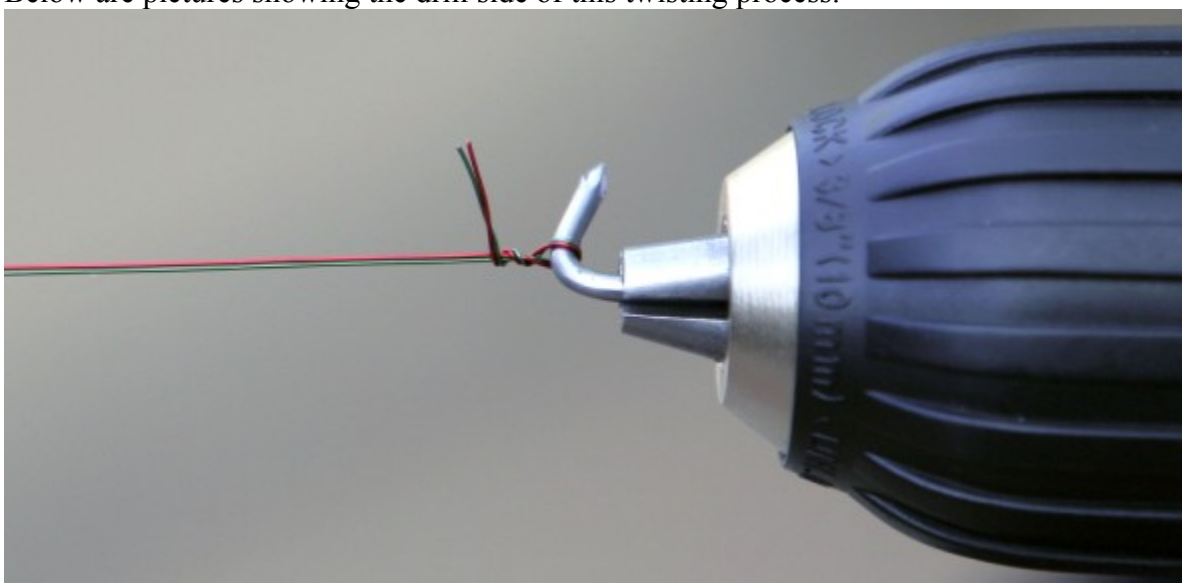

Figure 8. Bent nail in a Drill Chuck with two wires to be twisted

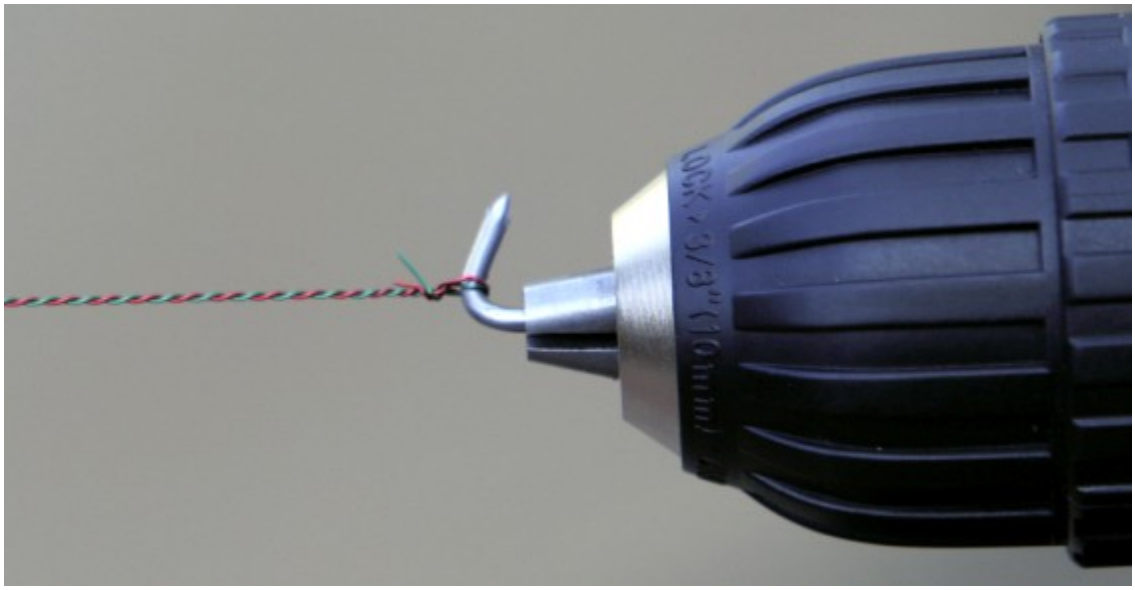

Figure 9. Wires after being twisted by the drill

After twisting the 3 foot, three wire set (Red/Green/Brown). Next measure off 1.5 more feet of green wire, and 1.5 feet of the thicker red wire used above. Now twist these two wires together (red/green) as was done above for the three wire pair.

At this point you now have three feet of twisted three wire, and 1.5 feet of twisted two wire. Any remaining brown wire is extra and will not be used. You will use a bit more green wire at the very end.

Cut off 7 inches of the twisted three wire length. Use this to place 8 turns on an FT37-43 core. The FT37-43 core is the dark core in the package.

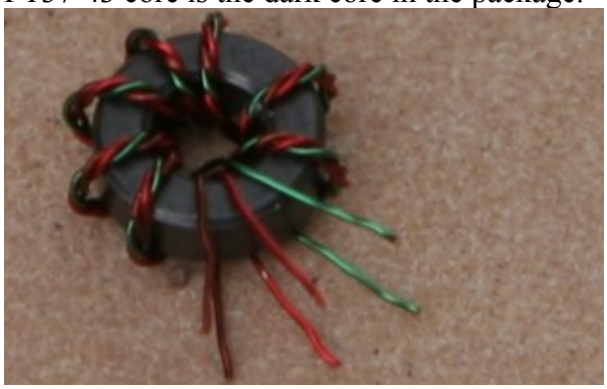

Figure 10. T6 details. FT37-43 core with 8 turns. Sort like colored wires across from each other.

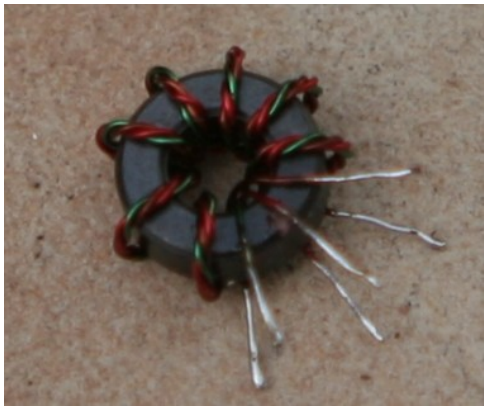

Figure 11. T6 details. Tin the wires, keeping the colors in the order above.

The red and green wires can be heat stripped using a blob of solder on the iron. However, the brown wire will need to be scraped using something sharp like a knife before being tinned.

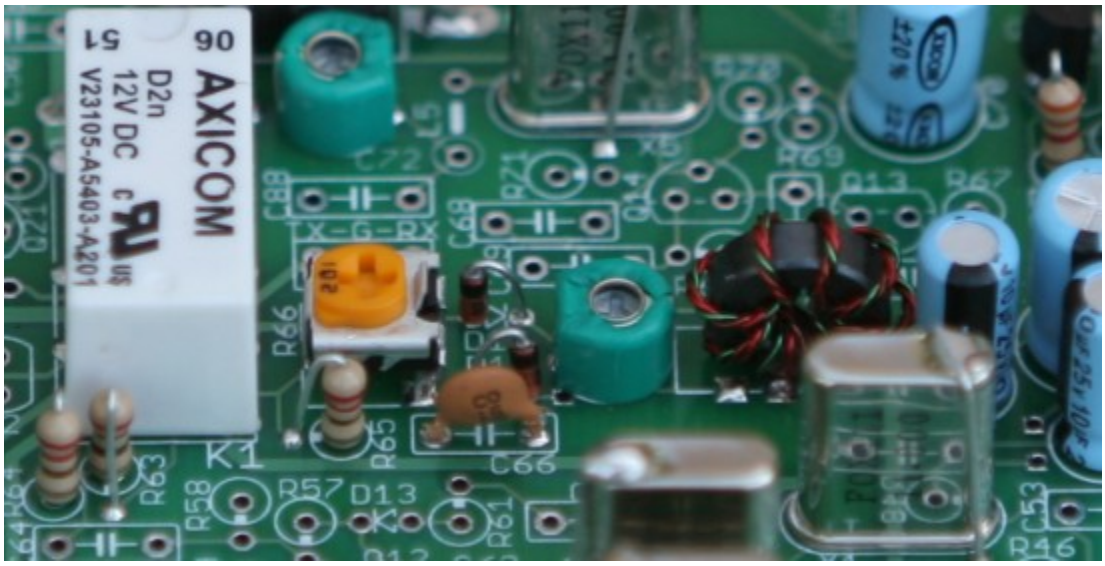

Figure 12. Second mixer installed including trifilar transformer T6. Diodes on end with band up.

Install ☐ T6 (wound in pictures above). T6 has three holes on each side. Use 7” of the pre-twisted 3 wire. ***Make sure color pairs are matched on both sides.*** The color order is not important. However if the order on one side is red/green/brown, the order on the other side should also be red/green/brown.

Install 1N4148 diodes. ☐ D14, ☐ D15. ***Double check diode orientation. Diodes shown band end up.***

Install 15 pf capacitor (marked “15”): ☐ C66

Install 220 ohm resistors (marked red-red-brown-gold): ☐ R64, ☐ R65

Install 22 ohm resistor (marked red-red-black-gold): ☐ R63

Second mixer test

The only test that can be done here is to make sure the wires were stripped and soldered in properly. From the top side, use an ohm meter to check for a short across each of the three pairs of T6 pads. If the three windings are properly soldered in place, each of the three windings will short out its own set of pads.

If a pad pair does not show a short, the wire needs to be recheck to make sure it was properly stripped, tinned and mounted in place.

Second mixer BFO

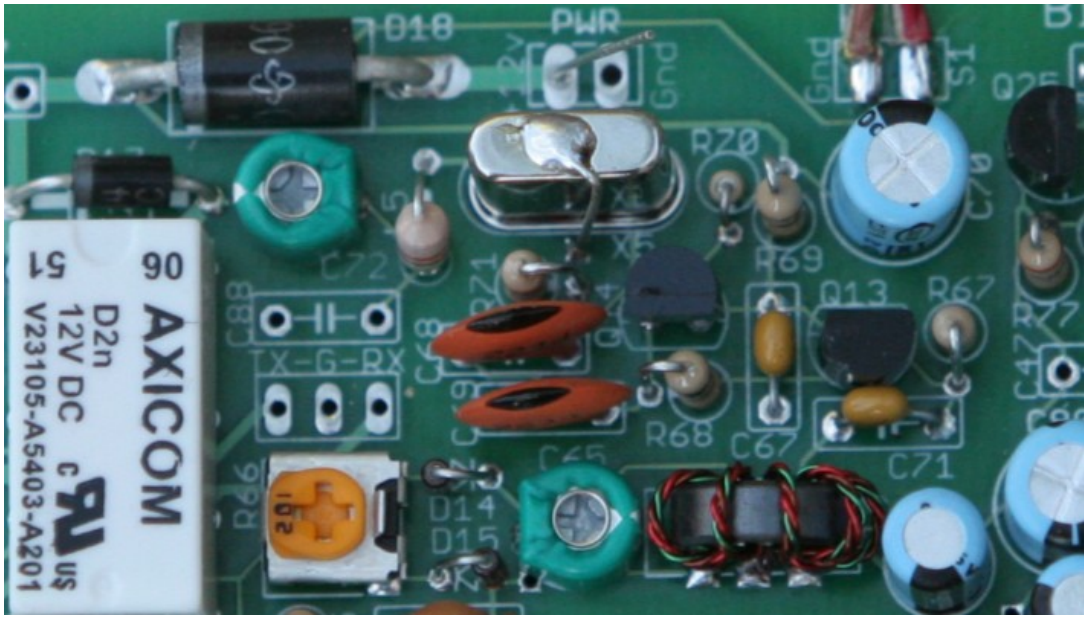

Figure 13. Second Mixer BFO Installed

Install 2N3904 transistors: ☐ Q13, ☐ Q14 **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C67, ☐ C71

Install 33 pf (marked "33") capacitor: ☐ C88 (not shown installed above)

Install 220 pf (marked "221") capacitor: ☐ C68, ☐ C69

Install 1K (marked brown-black-red-gold) resistors: ☐ R67, ☐ R68, ☐ R71

Install 150K (marked brown-green-yellow-gold) resistor: ☐ R70

Install 100 (marked brown-black-brown-gold) resistor: ☐ R69

Figure 14. L5 looks somewhat like fat resistor

Install an 8.2 uH molded choke inductor (grey-red-gold-gold): ☐ L5. See picture of L5 above.

Second mixer BFO Test

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 21 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 52 ma using a 12v supply.

At this time, remove the 12v power connection.

Second mixer test

The only test that can be done here is to make sure the wires were stripped and soldered in properly. From the top side, use an ohm meter to check for a short across each of the three pairs of T6 pads. If the three windings are properly soldered in place, each of the three windings will short out its own set of pads.

If a pad pair does not show a short, the wire needs to be recheck to make sure it was properly stripped, tinned and mounted in place.

Second IF Amp

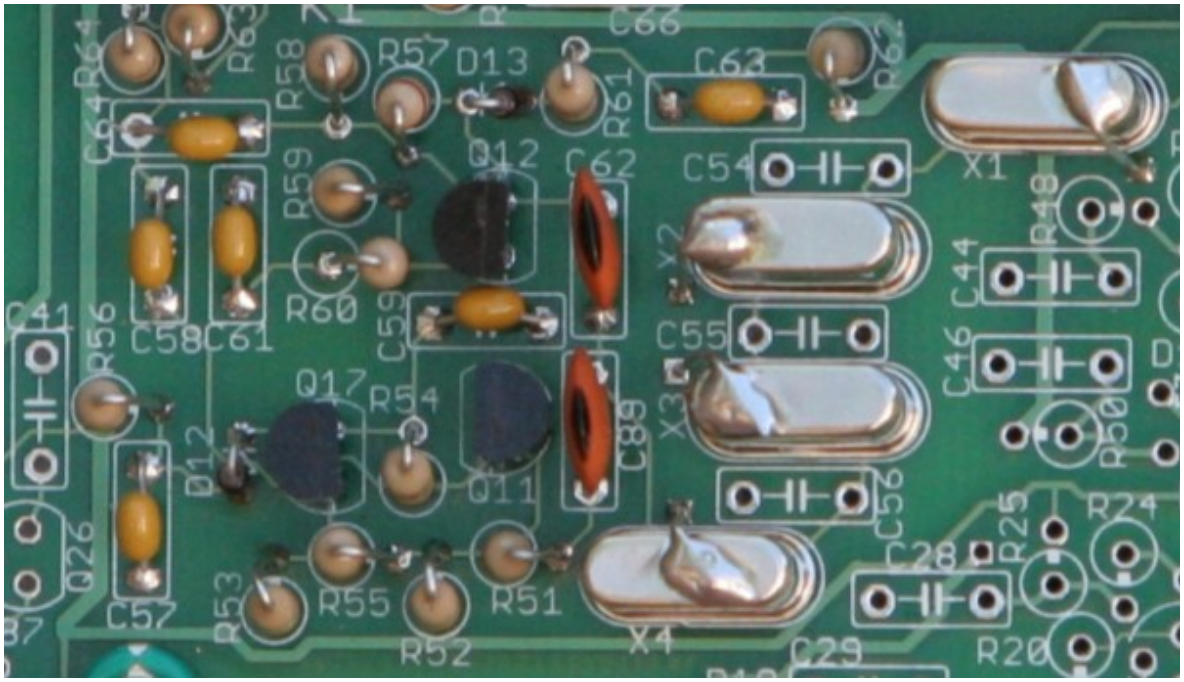

Figure 15. Second IF Amp

Install 2N3904 transistors: ☐ Q11, ☐ Q12, ☐ Q17. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C57, ☐ C58, ☐ C59, ☐ C61, ☐ C63, ☐ C64

Install 100 pf (marked "101") capacitor: ☐ C62, ☐ C89

Install 4.7 (marked yellow-violet-gold-gold) resistor: ☐ R60

Install 100 (marked brown-black-brown-gold) resistors: ☐ R56, ☐ R62

Install 220 (marked red-red-brown-gold) resistors: ☐ R51, ☐ R61

Install 470 (marked yellow-violet-brown-gold) resistor: ☐ R53, ☐ R59

Install 1K (marked brown-black-red-gold) resistors: ☐ R52, ☐ R58

Install 2.2K (marked red-red-red-gold) resistor: ☐ R57

Install 4.7K (marked yellow-violet -red-gold) resistors: ☐ R54, ☐ R55

Install 1N4148 diodes: ☐ D12, ☐ D13 – ***Double check diode orientation. Diodes shown band end up.***

Second IF Amp Test

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 31 ma.

☐ With the PTT switch open (receive) measure the voltage from the top of R53 to ground. The voltage should measure 3.8v.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 59.5 ma using a 12v supply.

☐ With the PTT switch closed (transmit) measure the voltage from the top of R59 to ground. The voltage should measure 2.0v.

At this time, remove the 12v power connection.

First IF Amp and Crystal Filter

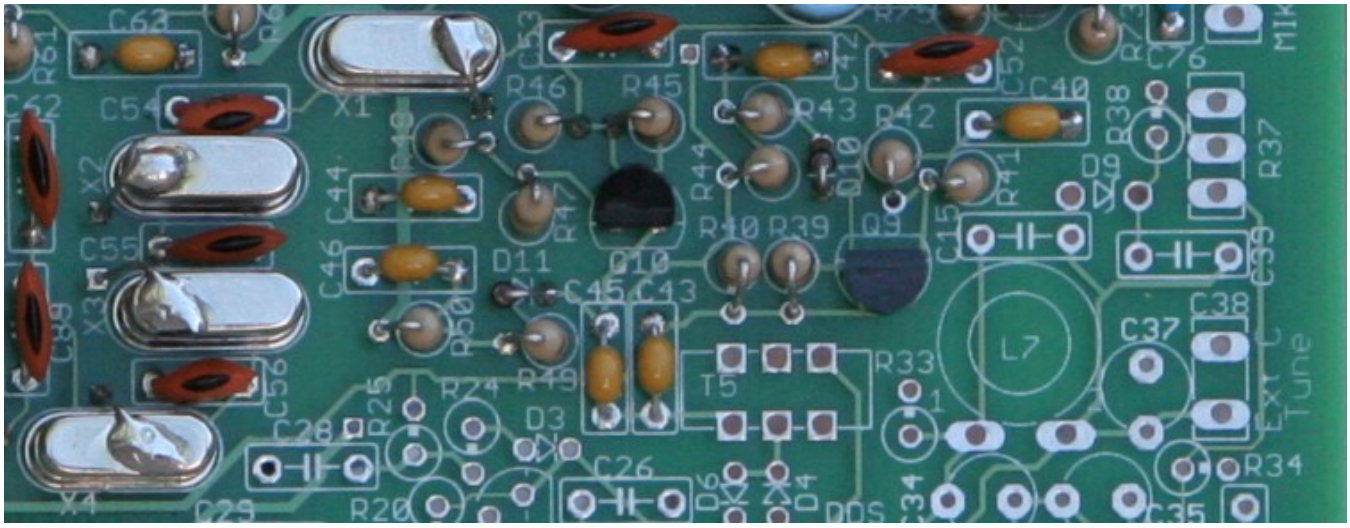

Figure 16. Second IF Amp and Crystal Filter

Install 2N3904 transistors: ☐ Q9, ☐ Q10. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C40, ☐ C42, ☐ C43, ☐ C44, ☐ C45, ☐ C46

Install 82 pf (marked "82") capacitor: ☐ C54, ☐ C56

Install 100 pf (marked "101") capacitor: ☐ C52, ☐ C53, ☐ C55

Install 10 (marked brown-black-black-gold) resistors: ☐ R42, ☐ R48

Install 100 (marked brown-black-brown-gold) resistors: ☐ R44, ☐ R50

Install 220 (marked red-red-brown-gold) resistors: ☐ R41, ☐ R43, ☐ R47, ☐ R49

Install 1K (marked brown-black-red-gold) resistors: ☐ R40, ☐ R46

Install 2.2K (marked red-red-red-gold) resistor: ☐ R39, ☐ R45

Install 1N4148 diodes: ☐ D10, ☐ D11 – ***Double check diode orientation. Diodes shown band end up.***

Second IF Amp Test

Sorry, I forgot to measure the current drain of this stage, but there are a few voltages that can be measured.

☐ With the PTT switch open (receive) measure the voltage from the top of R41 to ground. The voltage should measure 1.7v.

☐ With the PTT switch closed (transmit) measure the voltage from the top of R47 to ground. The voltage should measure 1.7v

At this time, remove the 12v power connection.

3 MHz VFO

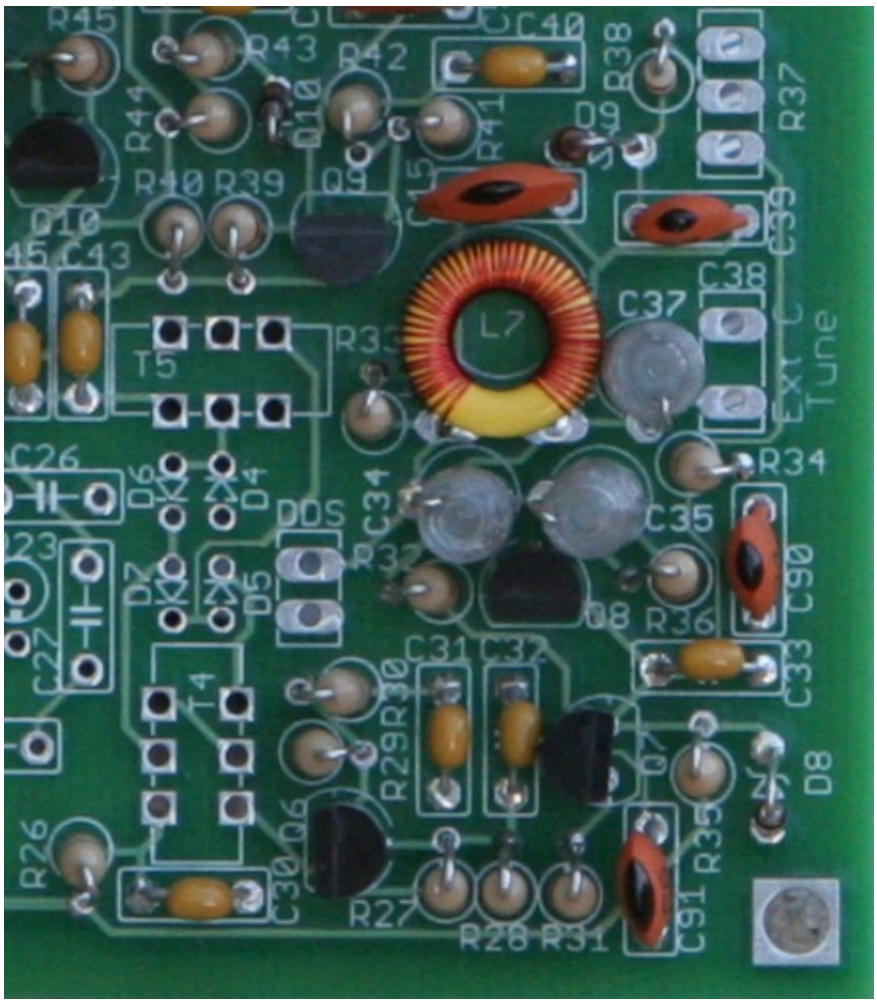

Figure 17. 3 MHz VFO

Install 2N3904 transistors: ☐ Q6, ☐ Q7, ☐ Q8. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C30, ☐ C31, ☐ C32, ☐ C33

Install 33 pf (marked "33") capacitor: ☐ C39, ☐ C90

Install 56 pf (marked "56") capacitor: ☐ C91

Install 180 pf (marked "181") capacitor: ☐ C15

Figure 18. A polystyrene capacitor

Install 220 pf Polystyrene (marked “220J”) capacitor: ☐ C37. ***This is not a disc cap. See picture of C37 above. Polystryene caps are large, clear caps with internal foil showing.***

Install 470 pf Polystyrene (marked “470J”) capacitor: ☐ C34, ☐ C35. ***This is not a disc cap. See picture of C34 & C35 above. Polystryene caps are large, clear caps with internal foil showing.***

Install 10 (marked brown-black-black-gold) resistors: ☐ R30

Install 100 (marked brown-black-brown-gold) resistors: ☐ R26, ☐ R29, ☐ R35

Install 1K (marked brown-black-red-gold) resistors: ☐ R27, ☐ R28, ☐ R31

Install 2.2K (marked red-red-red-gold) resistor: ☐ R36

Install 4.7K (marked yellow-violet-red-gold) resistors: ☐ R32

Install 10K (marked brown-black-orange-gold) resistors: ☐ R33, ☐ R34

Install 150K (marked brown-green-yellow-gold) resistors: ☐ R38

Install inductor: ☐ L7, T37-6 (yellow toroid core), 50T # 32. 3 ft of the smaller of the two kinds of red wire.

3 MHz VFO Test

☐ Connect 12v to the “PWR” pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 68 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 95 ma using a 12v supply.

At this time, remove the 12v power connection.

First Mixer

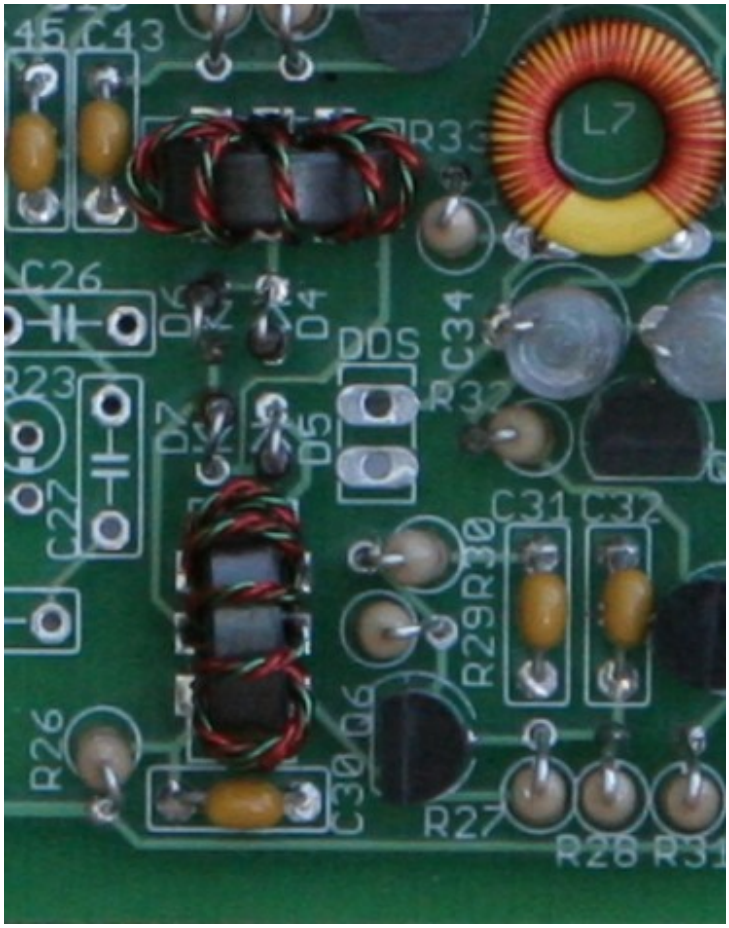

Figure 19. First Mixer Installed

Install 1N4148 diodes: ☐ D4, ☐ D5, ☐ D6, ☐ D7 – ***Double check diode orientation. Diodes shown band end up.***

Figure 20. T4/T5 details. FT37-43 core with 8 turns. Sort like colored wires across from each other.

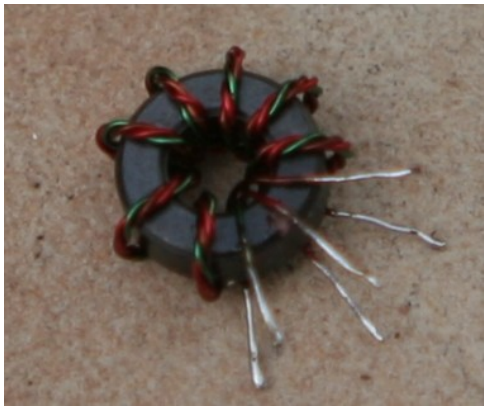

Figure 21. T4/T5 details. Tin the wires, keeping the colors in the order above.

Install ☐ T4, ☐ T5 (wound in pictures above). Both have three holes on each side. Use 7" of the pre-twisted 3 wire. ***Make sure color pairs are matched on both sides.*** The color order is not important. However is the order on one side is red/green/brown, the order on the other side should also be red/green/brown.

First Mixer Test

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 103 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 131 ma using a 12v supply.

At this time, remove the 12v power connection.

RF Amp

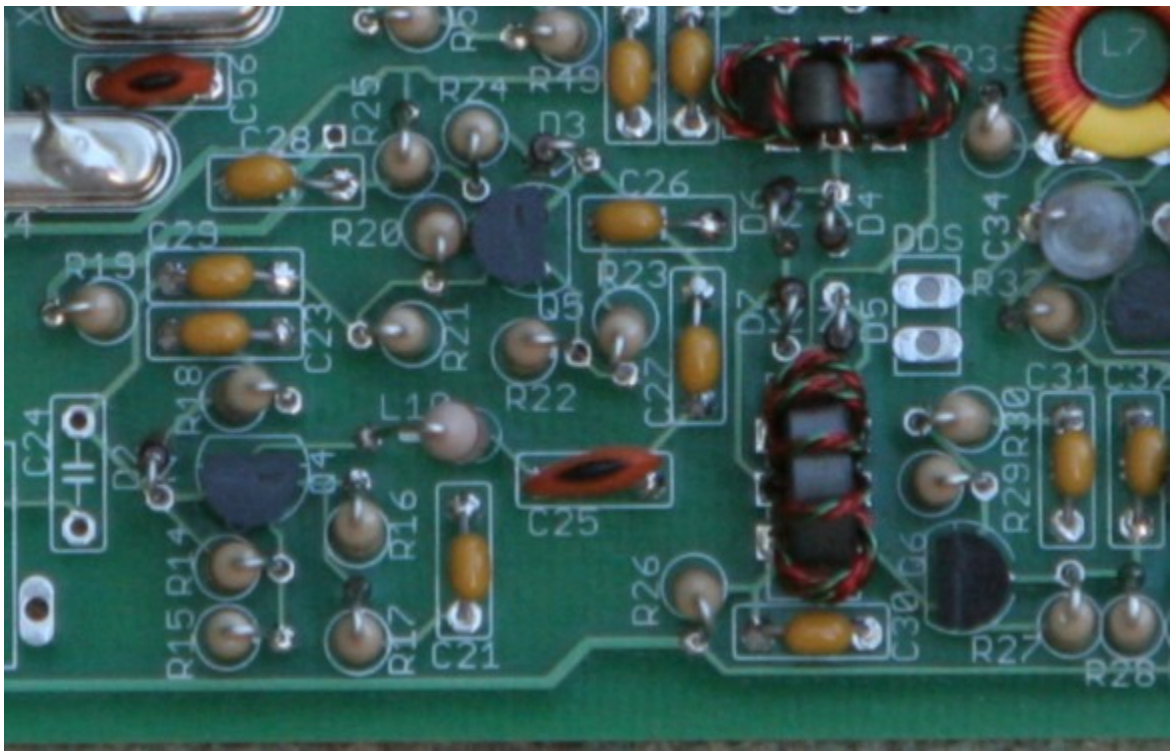

Figure 22. RF Amp

Install 2N3904 transistors: ☐ Q4, ☐ Q5. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C21, ☐ C23, ☐ C26, ☐ C27, ☐ C28, ☐ C29

Install 100 pf (marked "101") capacitor: ☐ C25

Install 10 (marked brown-black-black-gold) resistors: ☐ R17, ☐ R23

Install 100 (marked brown-black-brown-gold) resistors: ☐ R19, ☐ R25

Install 220 (marked red-red-brown-gold) resistors: ☐ R16, ☐ R18, ☐ R22, ☐ R24

Install 1K (marked brown-black-red-gold) resistors: ☐ R15, ☐ R21

Install 2.2K (marked red-red-red-gold) resistor: ☐ R14, ☐ R20

Install 1N4148 diodes: ☐ D2, ☐ D3 – ***Double check diode orientation. Diodes shown band end up.***

Figure 23. L10 looks some what like fat resistor

Install a 1.2 uH molded choke inductor (brown-red-gold-gold): ☐ L10. See picture of L10 above.

RF Amp Test

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 113 ma.

☐ With the PTT switch open (receive) measure the voltage from the top of R22 to ground. The voltage should measure 1.7v.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 140 ma using a 12v supply.

☐ With the PTT switch closed (transmit) measure the voltage from the top of R16 to ground. The voltage should measure 1.7v.

At this time, remove the 12v power connection.

Front End Filter

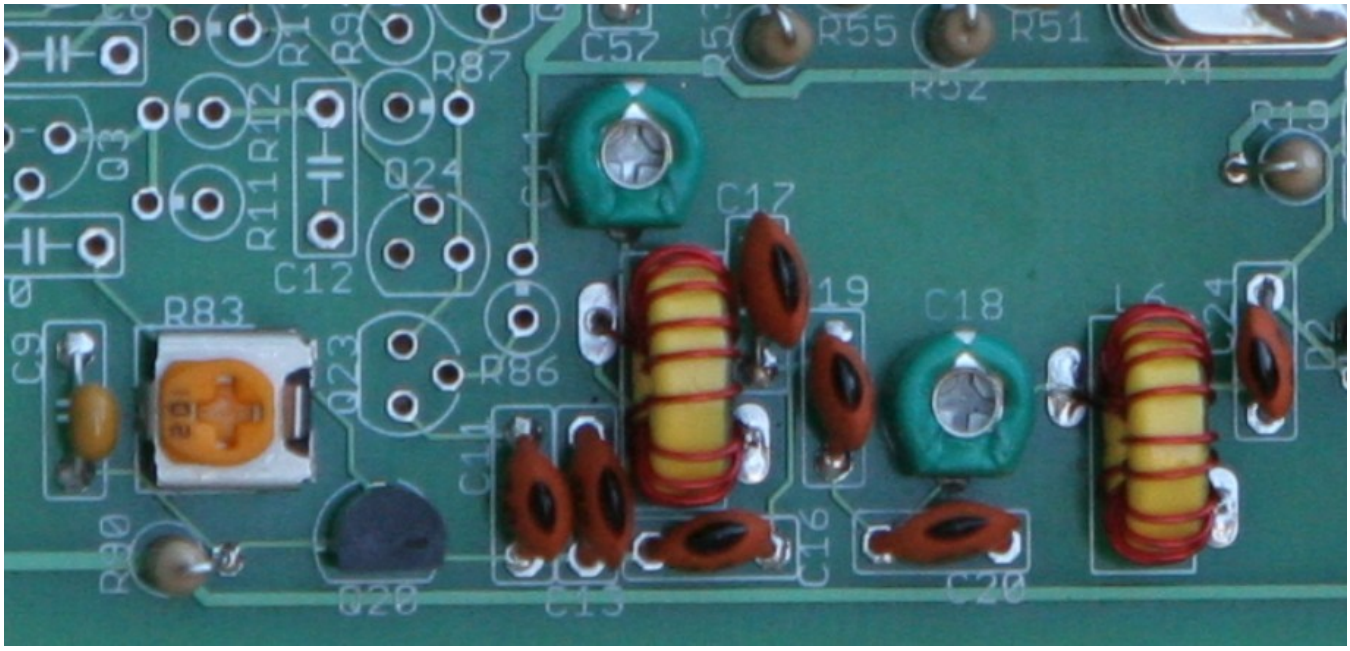

Figure 24. Front End Filter

Install 2N5486 transistor: ☐ Q20. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked "104") capacitor: ☐ C9

Install 8.2 pf (marked "8.2") capacitor: ☐ C24

Install 10 pf (marked "10") capacitors: ☐ C11, ☐ C16, ☐ C19

Install 56 pf (marked "56") capacitor: ☐ C17

Install 82 pf (marked "82") capacitors: ☐ C13, ☐ C20

Install 100 (marked brown-black-brown-gold) resistors: ☐ R90

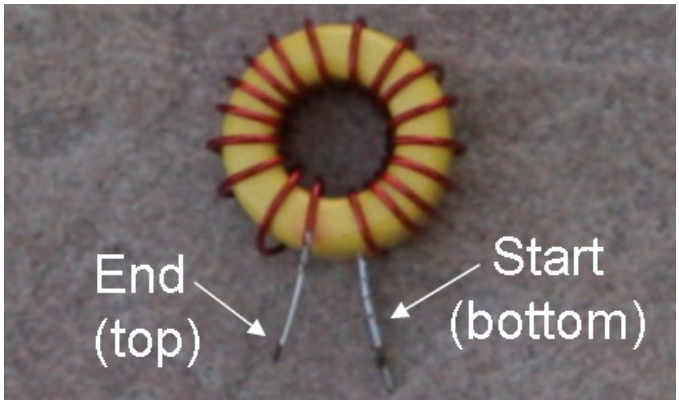

Figure 25. L4/L6 – 18T # 26 on a T37-6 core

Install inductors: ☐ L4, ☐ L6. Both are constructed the same: Wound on a T37-6 yellow toroid core using 18T # 26 red wire. Use 9 inches of the larger diameter of the two kinds of red wire.

These two toroids need to be wound a specific direction to fit properly on the board. Start the first turn by feeding the wire from the bottom on the core. With the left hand, hold the core and the short end of the wire. The short end will be against the bottom side of the core. Add windings counter clockwise. The last turn will end up being on top as shown.

Make sure to strip the leads before mounting these inductors. The red wire can easily be stripped using a blob of solder on the tip of a soldering iron. Start at the cut end of the wire.

Front End Filter Test

☐ A common problem is to not properly strip the leads of inductors before soldering them into the circuit. Place an ohm meter across C13 and then C20 to make sure the inductors L4 and L6 are properly shorted to ground. Both capacitors should show a short to ground if either does not show a short, then L4 or L6 are not properly installed and the insulation probably was not proper stripped.

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 118 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 145 ma using a 12v supply.

At this time, remove the 12v power connection.

Transmit/Receive Switch

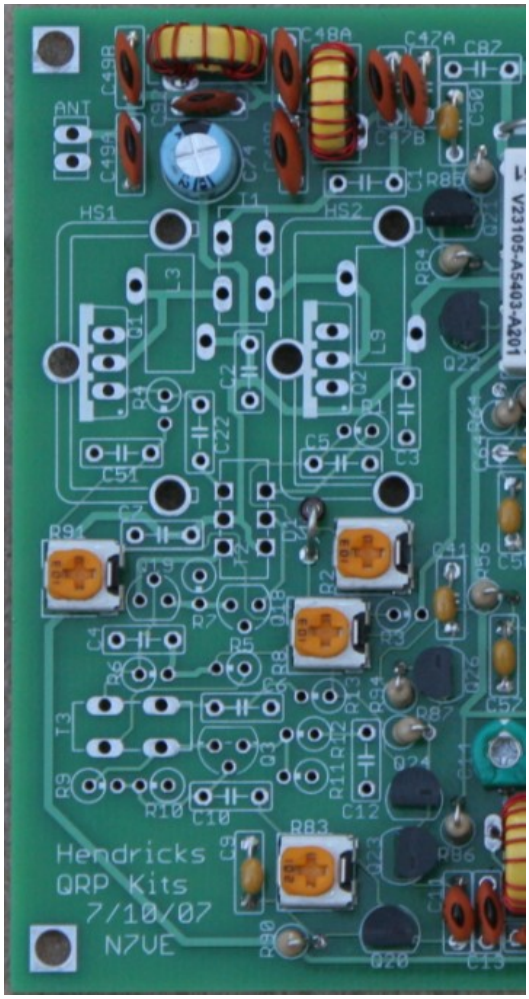

Figure 26. Transmit/Receive Switch

Install FQN1N50C transistor: ☐ Q21. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 2N7000 transistor: ☐ Q22, ☐ Q23, ☐ Q24, ☐ Q26. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 4.7K (marked yellow-violot-red-gold) resistors: ☐ R84, ☐ R85, ☐ R86, ☐ R87, ☐ R94

Install 0.1 uf (marked "104") capacitor: ☐ C41, ☐ C50

Install 68 pf (marked "68") capacitor: ☐ C92

Install 100 pf (marked "101") capacitors: ☐ C47A, ☐ C47B, ☐ C49A, ☐ C49B
Install 180 pf (marked "181") capacitors: ☐ C48A, ☐ C48B

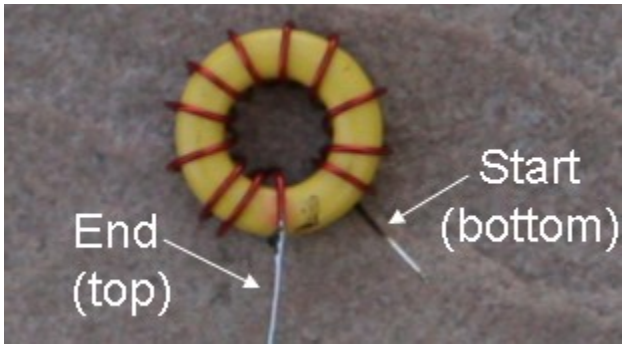

Figure 27. L1 – 12T # 26 on a T37-6 core

Install inductor: ☐ L1. If you installed C92 (68 pf), then you need 12T. If you did not use C92, then use 14T. Wound on a T37-6 yellow toroid core using # 26 red wire. Use 7 inches of the larger diameter of the two kinds of red wire.

This toroid needs to be wound a specific direction to fit properly on the board. Start the first turn by feeding the wire from the bottom on the core. With the left hand, hold the core and the short end of the wire. The short end will be against the bottom side of the core. Add windings counter clockwise. The last turn will end up being on top as shown.

Make sure to strip the leads before mounting these inductors. The red wire can easily be stripped using a blob of solder on the tip of a soldering iron. Start at the cut end of the wire.

Install inductor: ☐ L2. Wound on a T37-6 yellow toroid core using 14T # 26 red wire. Use 7 inches of the larger diameter of the two kinds of red wire. ***Wind like L1 above in a specific direction.***

Transmit/Receive Switch Test

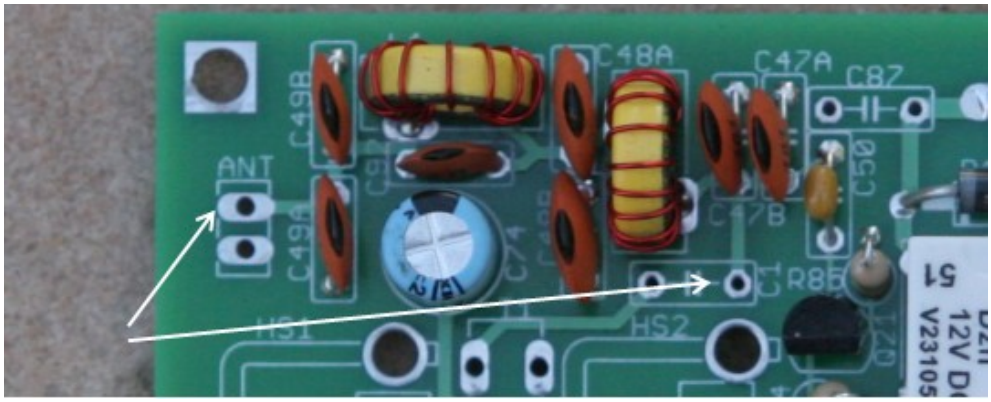

Figure 28. L1/L2 check. Place ohm meter across the two points shown.

☐ A common problem is to not properly strip the leads of inductors before soldering them into the circuit. Place an ohm meter as shown above to make sure the inductors L1 and L2 properly short these two point together. If this does not show a short, then either L1 or L2 are not properly installed and the insulation probably was not proper stripped.

☐ Connect 12v to the “PWR” pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 118 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 145 ma using a 12v supply.

There is nothing in the T/R switch stage that draws any additional current. This verifies that fact.

At this point, the receiver is complete and can be tested as a whole. However, the transmitter power amplifier stages still need to be built.

At this time, remove the 12v power connection.

Power Amplifier Driver

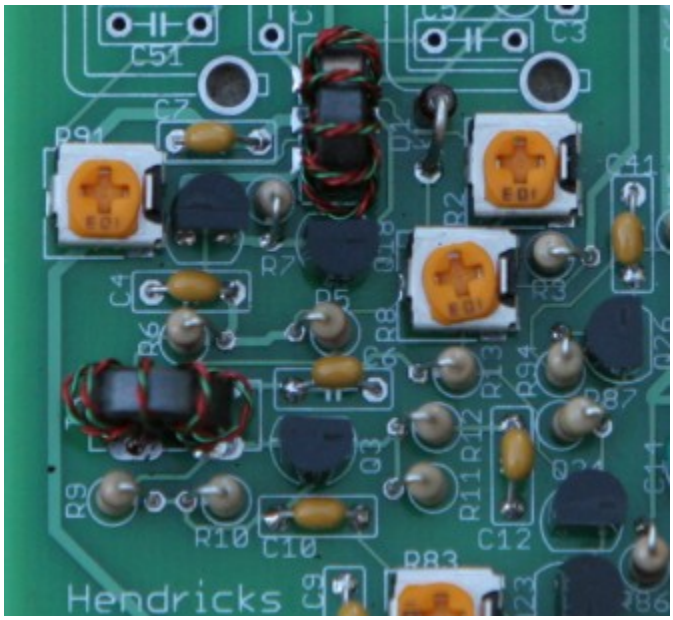

Figure 29. Power amplifier driver section. Note R2/R8/R91 trimmers turned fully counter-clockwise.

Install 2N3904 transistor: ☐ Q3. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install BS170 transistor: ☐ Q18, ☐ Q19. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Install 0.1 uf (marked “104”) capacitor: ☐ C4, ☐ C6, ☐ C7, ☐ C10, ☐ C12

Install 2.2 (marked red-red-gold-gold) resistor: ☐ R7

Install 10 (marked brown-black-black-gold) resistor: ☐ R12

Install 22 (marked red-red-black-gold) resistor: ☐ R13

Install 100 (marked brown-black-brown-gold) resistor: ☐ R11

Install 1K (marked brown-black-red-gold) resistors: ☐ R3, ☐ R10

Install 2.2K (marked red-red-red-gold) resistors: ☐ R5, ☐ R6, ☐ R9

Turn trimmer resistors filly counter clockwise as shown above: ☐ R2, ☐ R8, ☐ R91. This sets the bias voltage on the IRF511s (not installed) and the BS170s to zero voltage.

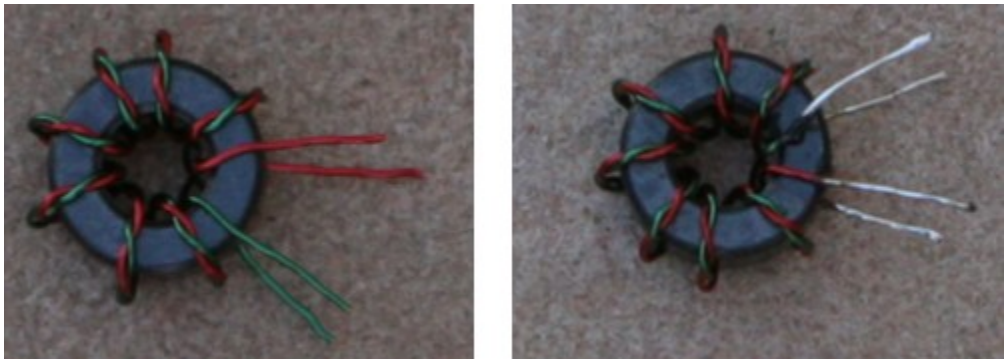

Figure 30. T3, 8T of 2 wire twisted pair wound on a FT37-43 Core

Install ☐ T3 (wound in pictures above). There are two holes on each side. Use 7" of the pre-twisted 2 wire. ***Make sure color pairs are matched on both sides.*** The color order is not important. However is the order on one side is red/green the order on the other side should also be red/green.

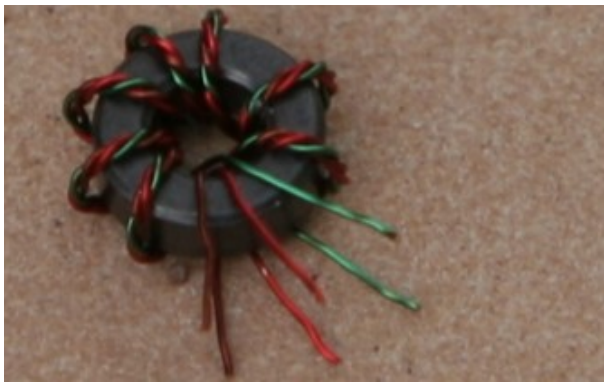

Figure 31. T2 details. FT37-43 core with 8 turns. Sort like colored wires across from each other.

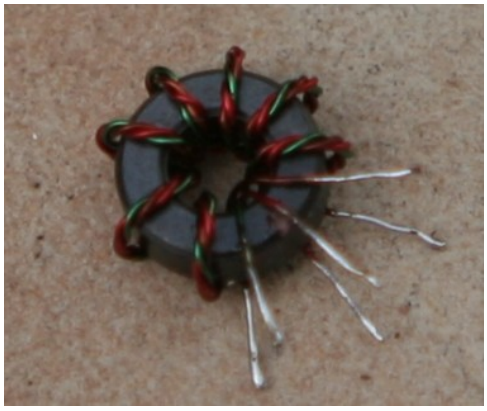

Figure 32. T2 details. Tin the wires, keeping the colors in the order above.

Install ☐ T2 (wound in pictures above). T2 has three holes on each side. Use 7" of the pre-twisted 3 wire. ***Make sure color pairs are matched on both sides.*** The color order is not important. However if the order on one side is red/green/brown, the order on the other side should also be red/green/brown.

Power Amplifier Driver Test

☐ Connect 12v to the "PWR" pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 118 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 178 ma using a 12v supply. ☐ Also measure the voltage across R11 to ground as 2.7v.

At this time, remove the 12v power connection.

Power Amplifier Finals

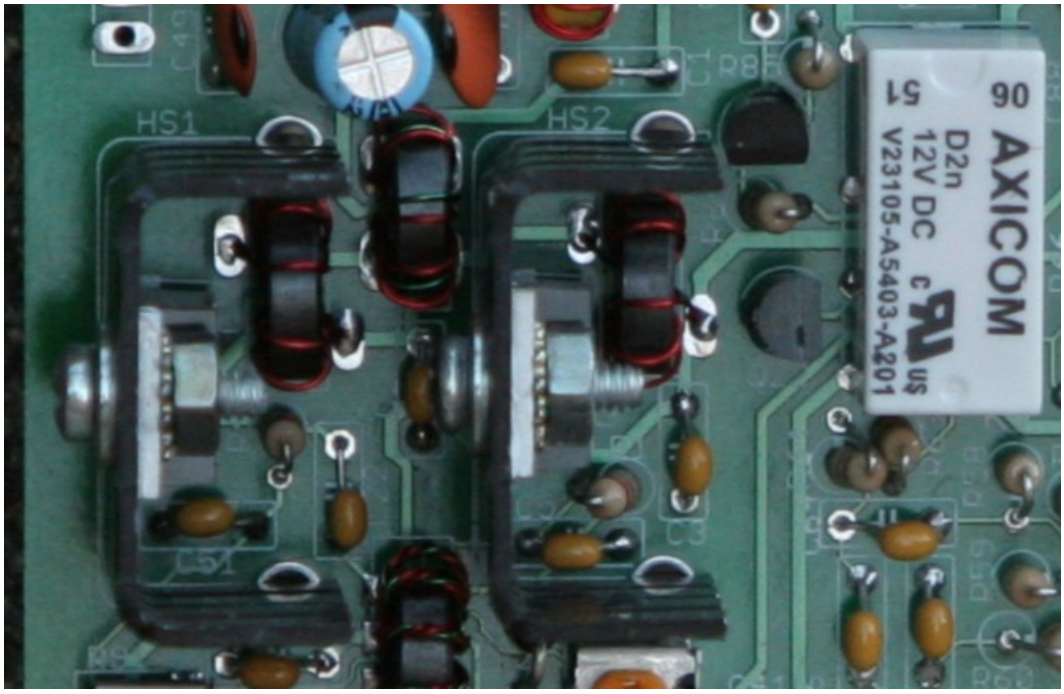

Figure 33. Power amplifier final section.

Figure 34. Winding details of T1. 8T red with 6T of green wound over the top of the red windings

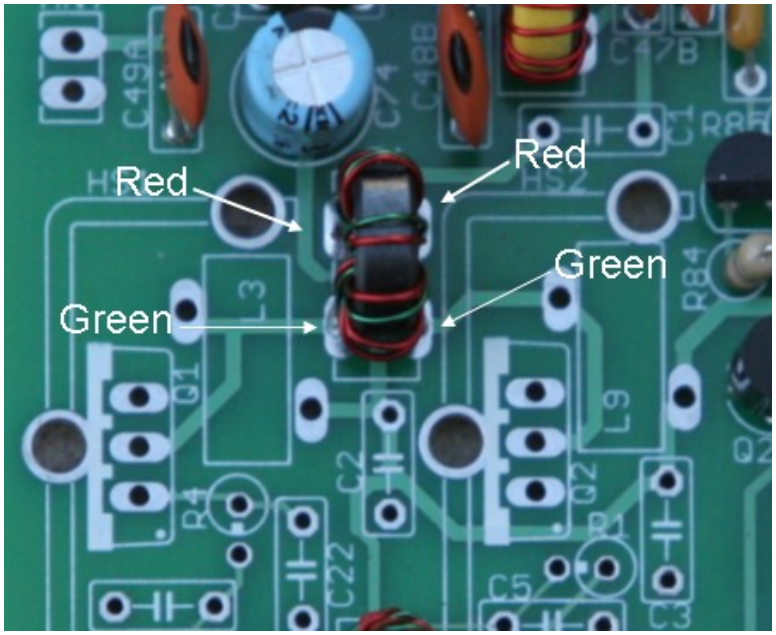

Figure 35. Installation details of T1

Install T1: ☐ T1. See pictures above for details. Use solid black FT37-43 core. First wind 8 turns of the larger red wire, then wind over it 6 turns of green wire. 8 inchs of wire for each is more than enough. Install with like colors opposite each other as shown in the figure above.

Install 0.1 uf (marked "104") capacitor: ☐ C1, ☐ C2, ☐ C3, ☐ C5, ☐ C22, ☐ C51

Install 2.2K (marked red-red-red-gold) resistors: ☐ R1, ☐ R4

Install L3, L9: ☐ L3, ☐ L9. Use al all black FT37-43 core. Wind 8 turns of the larger red wire using 8 inches of wire.

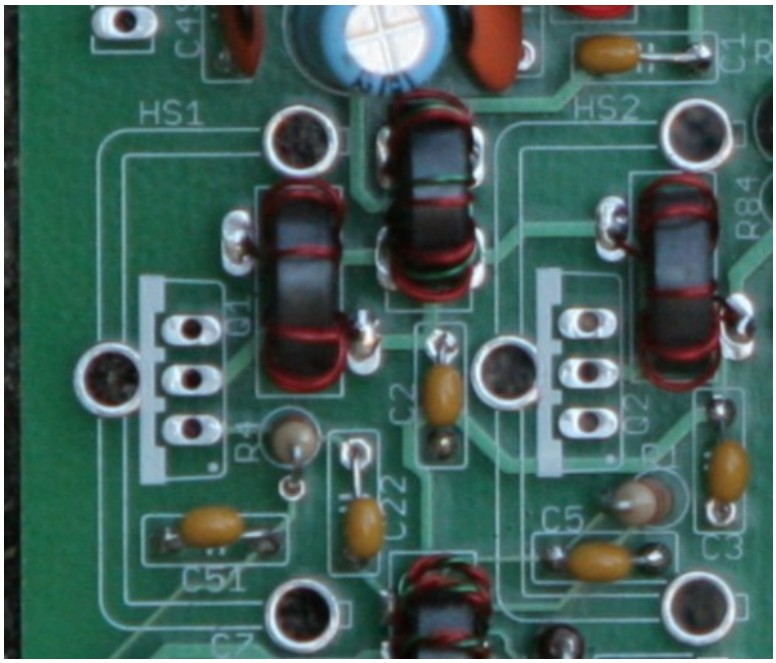

Figure 36. All parts installed except for the IRF510A finals + heat sinks

Figure 37. IRF510A transistors with heat sink compound applied to the back side

Coat the back side of both IRF510A transistors with heat sink compound. This is available at computer shops.

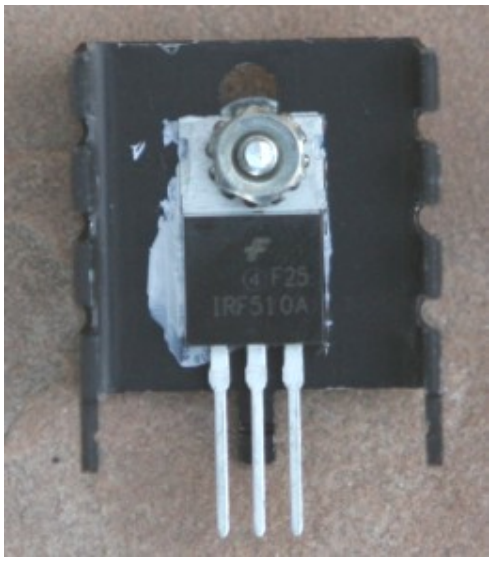

Figure 38. Heatsinks attached to IRF510As with 4-40 screws

Attach the heatsinks loosely to the transistor. Notice the thick section of the top of the transistor leads is flush with the bottom of the heatsink. This will allow the transistor leads to be as short as possible when installed on the PC board.

No insulators are used when attaching the heat sinks to the transistors. Thus the heat sinks will have 12v on them. The holes for the heatsinks are designed to be insulated from ground. These heat sinks have been sized for SSB duty cycle. The transmitter does not have heatsinks sized to handle 10w of

continuous power such as PSK. If continuous 10w output is desired, either larger heatsinks will be required or forced air fan cooling of the existing heat sinks.

When installing the IRF510s, the transistor leads hold the heatsinks in place. The leads of the heatsinks are not bent after installation. Tighten the screws holding the heatsinks after installation.

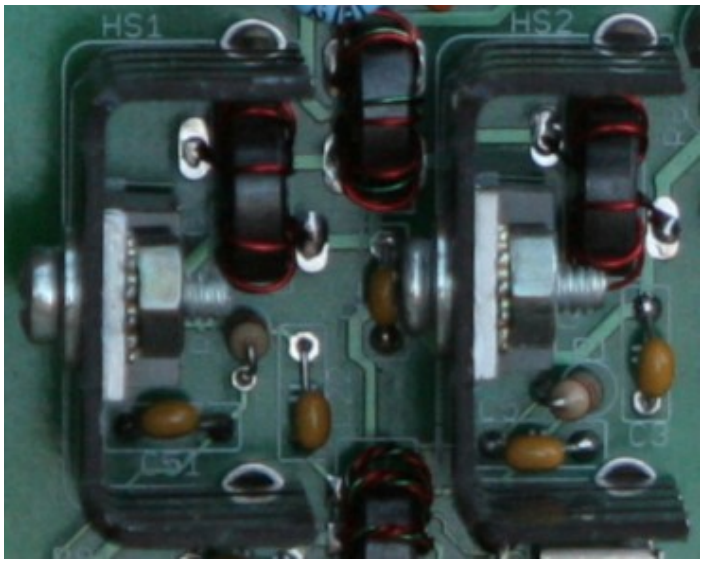

Figure 39. The heat sinks of the IRF510s are press mounted flush with the top of the PC board

Install IRF510 transistors: ☐ Q1, ☐ Q2. **Make sure the flat side matches up with the flat side on the board (see picture above)!**

Double check that the turn trimmer resistors filly counter clockwise as shown in the previous sections: ☐ R2, ☐ R8, ☐ R91. This sets the bias voltage on the IRF511s (now installed) and the BS170s to zero voltage.

Additional Non-Provided, Very Recommended Power Amplifier Modifications

Some builders have seen the final amplifier section go unstable when connected to an antenna. This final amplifier strip has plenty of gain, and stability can be greatly improved by adding two additional "load" resistors to two of the pre-driver stages. These two resistors can be added to the bottom of the PC board out of sight.

The modification came from Martien PE1BWI:

"My BITX-20 is not the famous kit but my own build unit. However I liked the PA design so I build that part of the kit last week. My unit also oscillated and I cured it by mounting a 220 Ohm resistor between connection point C6/R13 and the collector of Q3. In this way any parasitic effects from T3 (that could cause oscillation) are attenuated by the resistor. Further I also mounted a 1000 Ohm resistor between the drains of Q18 and Q19 for the same reason. The effect is that the amplifier is now absolutely stable under all antenna

impedances (open/ short, various phases).”

Power Amplifier Finals Test

☐ Connect 12v to the “PWR” pads along the top middle of the board. Measure the current drain with the PTT switch open (receive). The current drain should be 118 ma.

☐ Now close the PTT switch (transmit) and measure the current drain. The current should be about 178 ma using a 12v supply.

At this time, remove the 12v power connection.

These notes do not include instructions for RX/TX tune up and for setting the bias of the BS170s and the IRF510s.

The main point of this manual has been to provide enhanced build notes for less experienced builders. The primary goal has been to provide pictures, part details, mounting details, and section-by-section simple RX/TX tests to verify that each section appears to be working properly.

The hope is that a problem can be detected and isolated to the stage where the problem was introduced as the build progresses. Waiting to find problems at the end of the build can make it difficult to find the source of the problem.

Not shown are external parts such as attaching the polyvaricon to the VFO (C38), the VFO fine tune pot (R37), the headphone jack, microphone, 12v power jack and the antenna jack.